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EP 0643542 A1 EP 0522773 A2 WO 95/32594 A1
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INT CL[6] H04B 7/02 7/04 7/08 , H04L 1/02 1/06
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# (54) Method of Selecting a Signal

(57) A method of selecting data blocks in a signal selecting system is provided. The signal selecting system includes a base station operably coupled to a plurality of receivers for receiving data signals from remote units. The method includes the steps of receiving from a remote unit a plurality of data blocks of a data session at a first receiver and at a second receiver of the plurality of receivers of the base station and outputting from the base station, first receiver data blocks whilst holding in reserve data blocks from the second receiver. An output from the base station is switched from the first receiver to the second receiver during the data session if the relative signal quality changes.

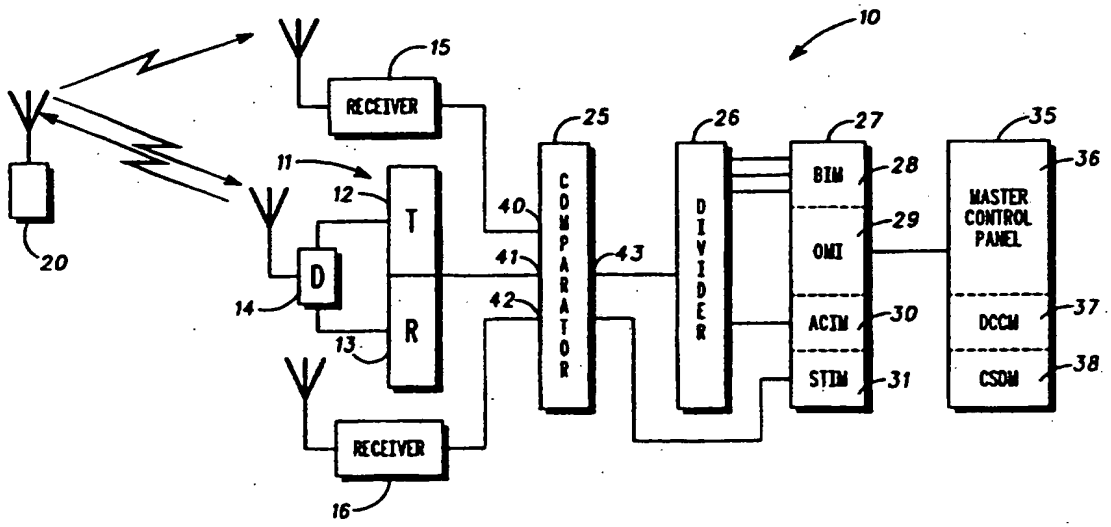


FIG.1

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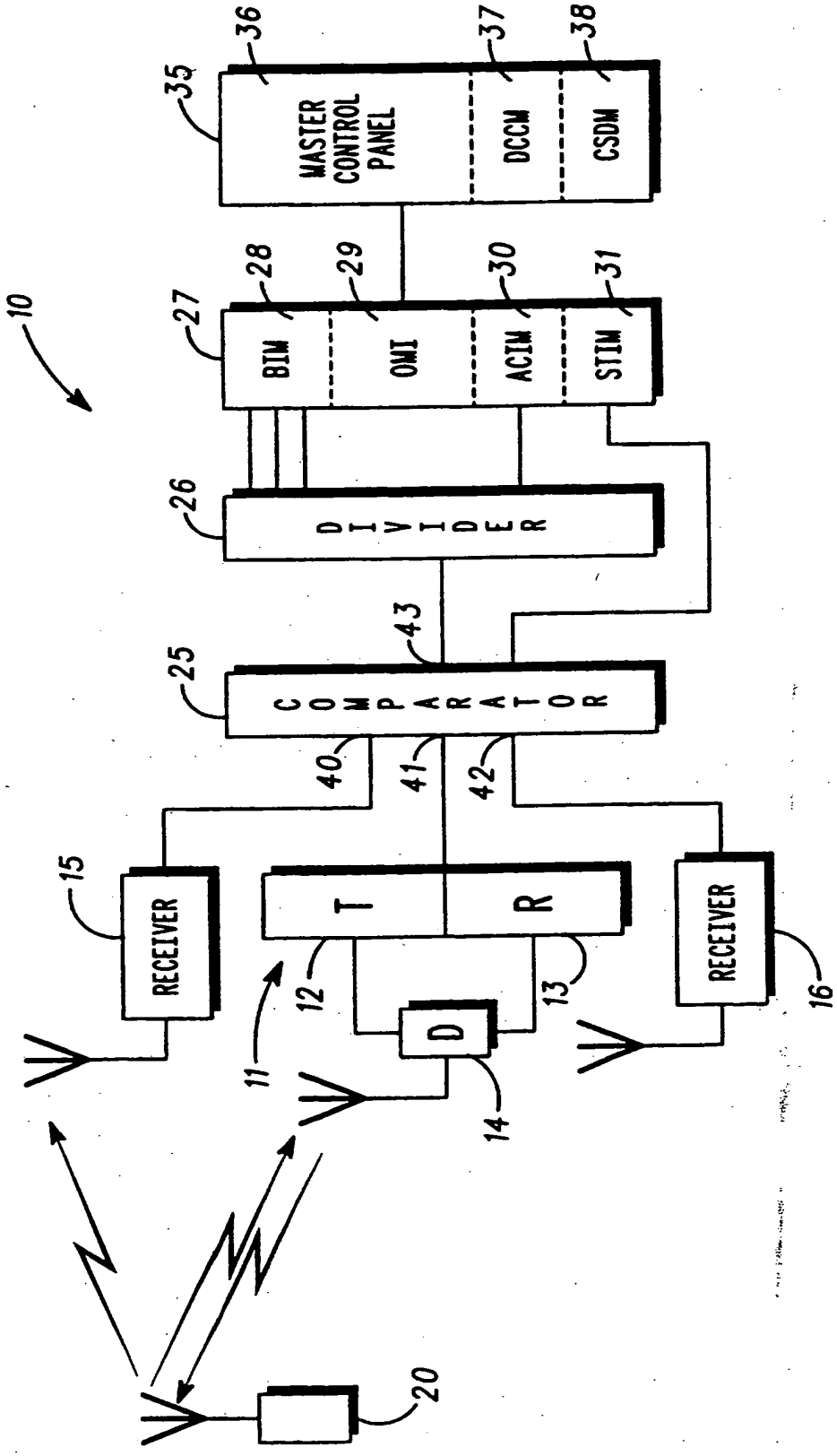
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.


10
35
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37
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MASTER CONTROL PANEL
DCCM
CSDM
27
28
29
30
31
BIM
OWI
ACIM
STIM
26
DIVIDER
43
25
COMPARATOR
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T
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12
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14
RECEIVER
16
20

FIG. 1

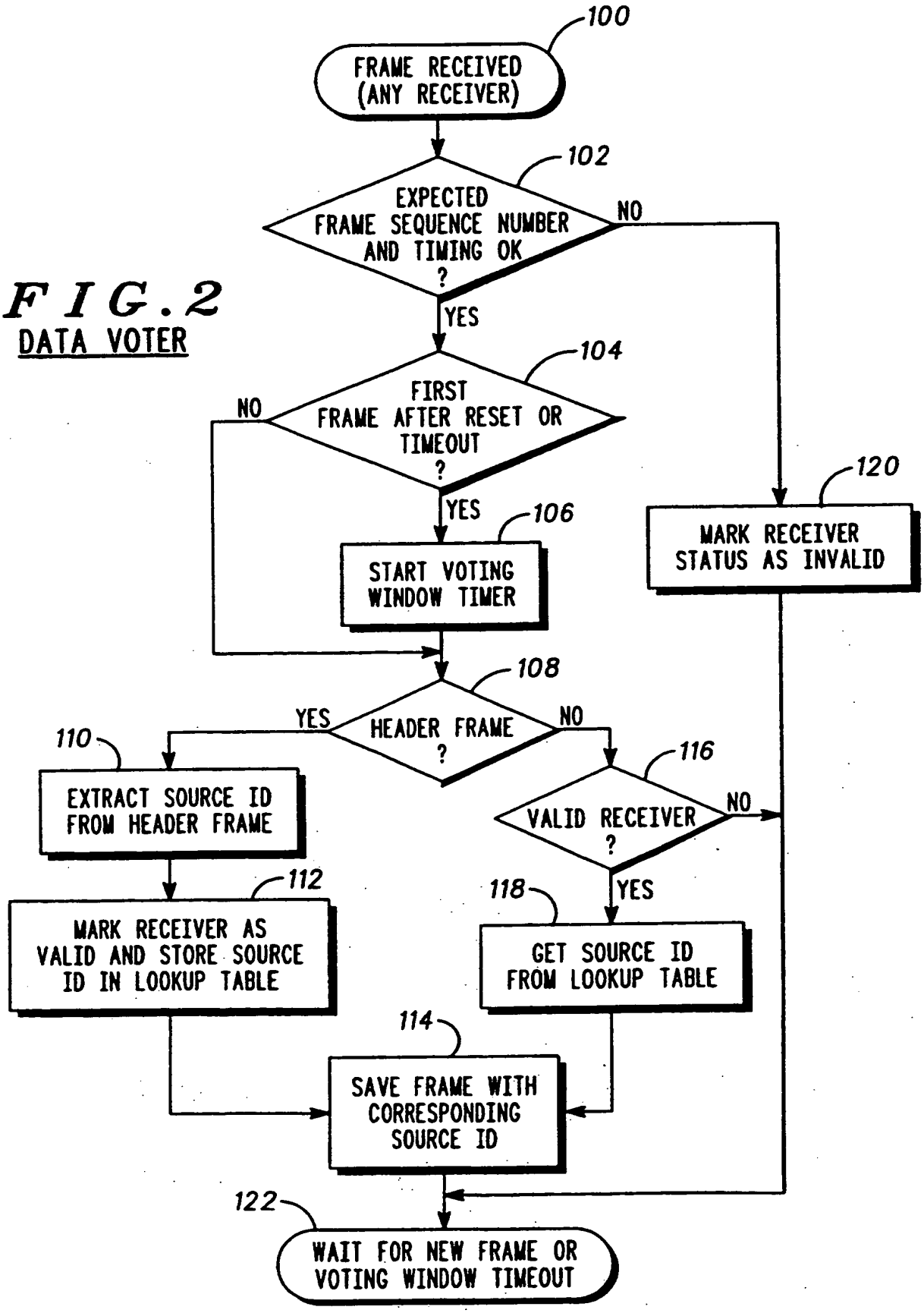


*FIG. 2*
DATA VOTER

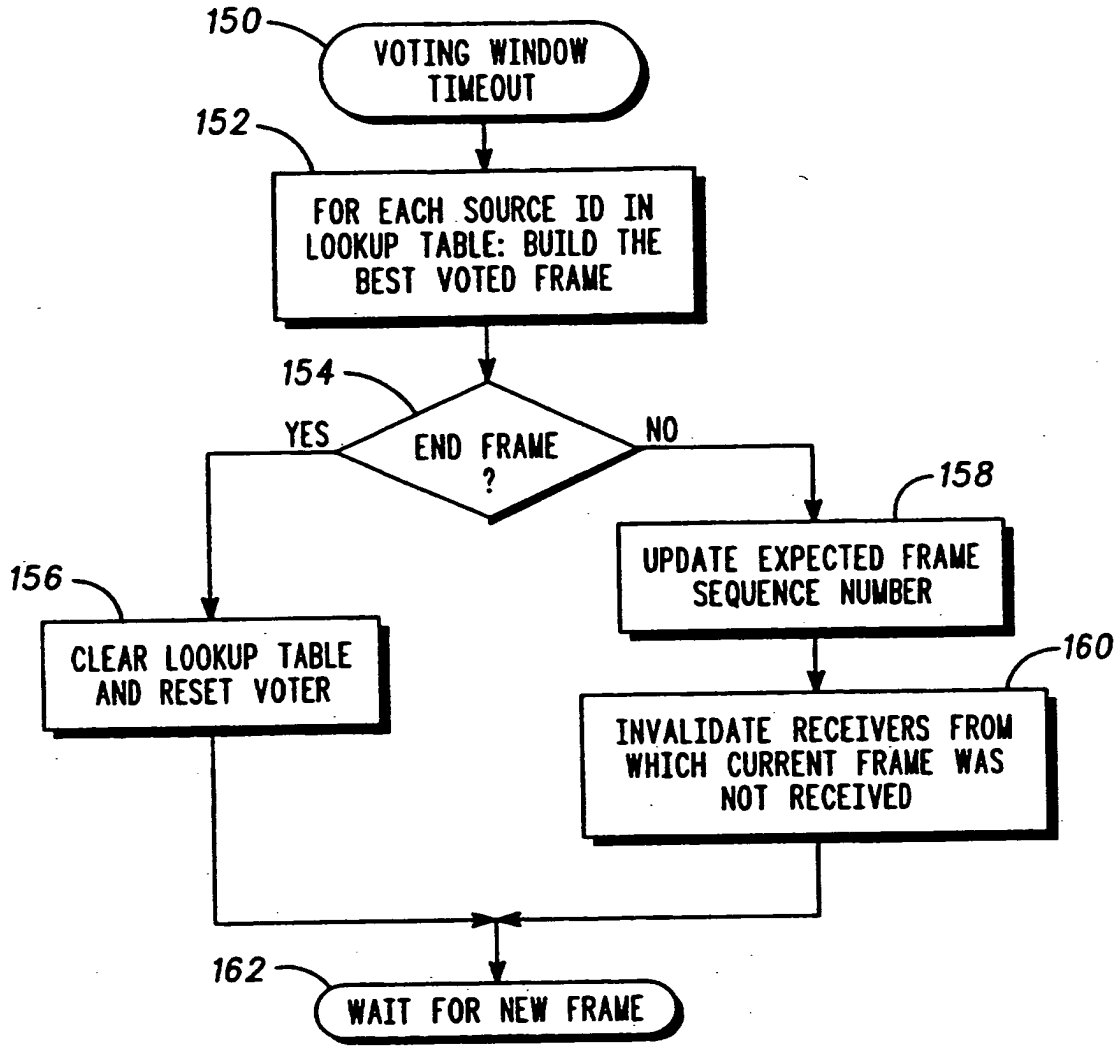


FIG. 3

VOTING WINDOW TIMER

| | RECEIVER 1 | RECEIVER 2 | RECEIVER 3 | RECEIVER 4 |
|---|---|---|---|---|
| STATUS | VALID | VALID | VALID | INVALID |
| SOURCE ID | SOURCE A | SOURCE A | SOURCE B | UNKNOWN |

200

FIG. 4

# METHOD OF OPERATION IN A SIGNAL SELECTING SYSTEM

## Field of the Invention

This invention relates to a method of operation in a signal selecting system. An example of such a system, without limitation thereto, is a comparator of a private mobile radio system.

## Background of the Invention

In "conventional" (i.e. non-trunked) wide area radio systems, it is usual to employ a comparator, that is to say a signal selecting and switching device. In an analog system, for example, a "Motorola" (trade mark) "Spectratac" comparator can be used to switch between one of a number of base stations and a console for dispatch communication between a controller and mobile radios in the field. The comparator performs voting, selection and emergency pre-emption.

With the development of digital communication, voice and data communication takes place in block divided signals, where each block includes voice coding and/or error correction and a complete block must be buffered and communicated from end-to-end for any portion of the block to be usable at the destination. This requires buffering of the data which introduces a degree of delay. Delay in the communication is inconvenient and irritating to the user and must be kept at a minimum.

A feature of a digital comparator is the resumption of a communication that has previously been interrupted through pre-emption by a higher priority communication, or that has commenced but has not been selected due to an on-going higher priority signal. Digital comparators employ buffering of the signal in preparation for its resumption.

In a voted system with multiple receivers, data is received at a number of receivers and then a particular receiver's data is voted to be further processed. In present systems a source identification parameter that links the data to a particular receiver is only present in a header frame. Typically, after voting a header frame, the voter locks to the selected receiver until the end of a data session. Thus, no voting will take place for the succeeding frames. The frames will be taken directly from the selected receiver without further voting. This increases the risk for getting errors in the received data session, especially for long data sessions. Even if non-header blocks are voted

they have no source identification parameters and may be mixed with different data from different sources.

Thus, there is a need for an improved method of voting in a signal selecting system.

## Summary of the Invention

According to the present invention, a method of selecting data blocks in a signal selecting system, is provided. The signal selecting system includes a base station operably coupled to a plurality of receivers for receiving data signals from remote units. The method includes the steps of receiving from a remote unit a plurality of data blocks of a data session at a first receiver and at a second receiver of the plurality of receivers of the base station and outputting from the base station, first receiver data blocks whilst holding in reserve data blocks from the second receiver. An output from the base station is switched from the first receiver to the second receiver during the data session.

A preferred embodiment of the invention is now described, by way of example only, with reference to the drawings.

## Glossary of Terms

| | | |
|---|---|---|
| ACIM | - | Astro (trade mark) Console Interface Module |
| BIM | - | Base Station Interface Module |
| CEB | - | Centralised Station Interface Module |
| CSDM | - | Comparator Status Display Module |
| DCCM | - | Display Channel Control Module |
| DIU | - | Digital Interface Unit |
| HDLC | - | High Level Data Link Control |
| LDU | - | Link Data Unit |
| STIM | - | Status Interface Module |
| TDM | - | Time Division Multiplex |
| VSELP | - | Variable Slope Excitation Linear Prediction |

Brief Description of Drawings

FIG. 1 shows, in outline, a signal selecting system in accordance with the preferred embodiment of the invention.

FIG. 2 shows a flowchart illustrating the process of data in the system of FIG. 1 according to a preferred embodiment of the invention.

FIG. 3 shows a flowchart illustrating an operation of a voting window timer in the system of FIG. 1 according to a preferred embodiment of the invention.

FIG. 4 shows an example of a look up table according to an embodiment of the present invention.

Detailed Description of the Drawings

FIG. 1 is an overall block diagram of a radio communications system having a signal selecting system. The radio system is a wide area system and is a "conventional" system in the sense that it is not a trunked radio system, i.e. it does not have a central trunking controller.

The radio system 10 comprises a transceiving base station 11 and remote or "satellite" receivers 15 and 16. The transceiving base station 11 includes a transmitting part 12, a receiving part 13 and a duplexer 14.

An arrangement of this nature provides wide area coverage when compared with a single base station system, in that the receivers 15 and 16 are able to receive signals from a mobile radio 20 when the mobile radio 20 is in remote areas of coverage. The uplink signal transmitted by the mobile radio 20 is generally weaker than the downlink signal transmitted by the base station 11, so that, while the base station 11 is able to transmit to the entire coverage area of the system, it is not necessarily able to receive the weaker signal transmitted by the mobile radio 20 from outlying areas of coverage. The receivers 15 and 16 enable reception from the mobile radio 20 in these outlying areas.

It will, of course, be understood that base stations in addition to base station 11 can be included in the system, as well as receivers in addition to receivers 15 and 16.

The system 10 further comprises a comparator 25. The term "comparator" is used in the art of private mobile radio to refer to a signal selecting and switching device.

The comparator 25 has a number of ports, of which four are shown (ports 40-43). Port 43 is connected to a digital interface unit 26 which is in turn connected to a CEB 27. The CEB 27 comprises a BIM 28, an OMI 29, an ACIM 30 and STIM 31. The CEB 27 is connected to a console 35 which comprises a master control panel 36 a DCCM 37 and a CSDM 38. Ports 40, 41 and 42 of the comparator 25 are connected to receiver 15, base station 11 and receiver 16 respectively.

Some of the elements shown in FIG. 1 are optional. For example, not all systems include console 35.

In operation, the comparator 25 receives signals from the receivers 15 and 16 and the base station 11 and from the DIU 26 and it sends signals to the base station 11 and to the DIU 26.

The comparator 25 sets up an uplink channel for passing signals from the receivers 15 and 16 or the base station 11 to the DIU 26 and it sets up a downlink channel for passing signals from the DIU 26 or from one of the receivers 15 or 16 to the base station 11 for transmission by the transmitter part 12.

The comparator 25 compares received signals from the base station 11 and from the receivers 15 and 16 and selects one to one of these signals for passing, i.e. routing, to the console 35.

One of the advantages of the present invention is that the data from different sources (or receivers) does not get mixed up when voting the data session. For example, data is likely to be mixed if two or more sources initiates a data session within a time window that is equal to the voting window. Some receivers might receive from one source and others from another source. For the present explanation, a data session consists of a number of data frames.

The first frame in a data session, commonly referred to as frame 0, is defined as the header frame. The last frame is the end frame. Each frame may be further subdivided into blocks. Thus, each frame may have 1-n blocks. In a voted system with multiple receivers, the data voter may make a best block selection based on a quality measure. When all the blocks have been processed, the voted session consists of all the best selected blocks. Thus, the present invention enables a block by block voting without mixing data from different sources.

Referring now to FIG. 2, a flowchart illustrating the method of data voting in the system of FIG. 1 is shown, according to a preferred embodiment of the invention. A frame is received at any receiver, as shown in step 100, and the frame is assessed to see if it is the expected frame sequence and

whether the timing of the signal is correct, as in step 102. If this is not the expected frame sequence or the timing of the signal is not correct, the receiver is marked as invalid, as shown in step 120, and a new frame is waited for, as in step 122. If the frame was the expected frame sequence and the timing of the signal was correct, the frame is assessed to see whether it is the first frame after reset or whether time-out has been initiated, as shown in step 104. If not the frame is checked to see whether it is a header or not, as in step 108. If it was the first frame after reset or time-out a voting window timer is initiated, as in step 106, and then the frame is checked to see if it was a header, as in step 108.

When the frame is a header frame, the source identification parameter is extracted, as in step 110, the receiver is marked as valid and the source identification parameter is stored in a memory block, e.g. look-up table, as shown in step 112. The frame is then saved with the respective source identification parameter, as in step 114. The source identification may be used to indicate what mobile unit or terminal transmitted the data signal.

When the frame is not a header frame, there is a check to see whether the receiver is valid or not as in step 116. If the receiver is not valid, the voter waits for a new frame, as shown in step 122. If the receiver is valid, the source identification parameter is extracted from the memory block, as shown in step 118, and the frame is then saved with the respective source identification parameter, as in step 114. The voter then waits for a new frame, as shown in step 122.

Referring now to FIG. 3, an embodiment of the voting window timer is described. The voting procedure is started as in step 150. For each source identification listed in the look up table, formed as described above, the best voted frame is built, step 152, until the end of the frame is determined, step 154. If it is not the end of the frame as determined in step 154, then the expected frame sequence number, representing a block signal, is updated, step 158. The receivers from which the current frame was not received are invalidated as in step 160 and the procedure waits for a new frame as in step 162. If it is determined in step 154 that it is the end of the frame then the look up table is cleared and the voter is reset, step 156.

An example of a look up table that may be used by the present invention is shown in FIG. 4. Fig. 4 shows an example of a look up table 200 after voting. The table 200 shows reception of valid frames from receivers 1, 2 and 3. Furthermore, it shows that header frames from receivers 1 and 2 originates from source A while the header frame from receiver 3 originates

from source B. If no header frame is received from receiver n the source is unknown.

The example in the table 200 of FIG. 4 means the following for the rest of the frames in the session. All succeeding frames from receiver n are ignored. Frames from receiver 1 and 2 are marked as originating from source A, while frames from receiver 3 are marked as originating from source B.

The voted data session is built up of best selected blocks received from the same subscriber. The voter can either output a voted frame for each source ID, or select the first source ID received to have priority and only output one best voted session.

If a receiver does not receive a frame within the voting window, it will be marked as invalid and excluded for the rest of the session. Exclusions are required to make sure that all voted receivers are in synchronism with the data session.

Advantageously, the present invention provides a method of efficiently selecting data blocks in a signal selecting system. In the present invention a base station may be operably coupled by a radio link to a plurality of receivers. The receiver are for receiving data signals from remote units. The present invention provides the steps of receiving from a remote unit a plurality of data blocks of a data session at a first receiver and at a second receiver. The invention includes outputting from the base station, the first receiver data blocks whilst holding in reserve data blocks from the second receiver. This allows switching an output from the base station from the first receiver to the second receiver during the data session, if necessary.

The present invention also provides a method of selecting data blocks in a signal selecting system including the steps of receiving a block divided first signal at a first receiver of the plurality of receivers, extracting an identification parameter from the block divided first signal and storing the identification parameter in a first memory block operably coupled to the first receiver, receiving the block divided first signal at a second receiver of the plurality of receivers, extracting the identification parameter from the block divided first signal and storing the identification parameter in a second memory block operably coupled to the second receiver. Thus, allowing selecting successively at least one block divided first signal to output from at least one of the first and second receivers of the plurality of receivers of the signal selecting system.

The steps of extracting an identification parameter from the block divided first signal and storing the identification parameter in first and second

memory blocks, may further include monitoring a signal quality parameter at the first and second receivers and storing respective first and second signal quality parameters with the identification parameter in the first and second memory blocks.

Thus, each data block received at the plurality of receivers may be assigned a signal quality parameter by the respective receiver. The signal quality parameters of the received data blocks at the first and second receivers may be compared and in response thereto a preferred receiver from which to output data blocks may be selected.

In a further embodiment a signal quality threshold level may be used to switch from the first receiver to the second receiver during the data session in the step of switching.

According to an embodiment of the present invention the identification parameter is placed in at least one header frame of a data session and the identification parameter indicates the source of a received signal.

Advantageously, the present invention allows block by block voting without mixing data from different sources. Thus, an improved method of voting in a signal selecting system is provided by the present invention.

Claims

1. A method of selecting data blocks in a signal selecting system, having a base station operably coupled to a plurality of receivers for receiving data signals from remote units, the method comprising the steps of:

receiving from a remote unit a plurality of data blocks of a data session at a first receiver and at a second receiver of the plurality of receivers of the base station;

outputting from the base station, first receiver data blocks whilst holding in reserve data blocks from the second receiver; and

switching an output from the base station from the first receiver to the second receiver during the data session.

2. A method of selecting data blocks in a signal selecting system, having a base station operably coupled to a plurality of receivers for receiving data signals, wherein the base station further includes a memory element having a plurality of memory blocks, the method comprising the steps of:

receiving a block divided first signal at a first receiver of the plurality of receivers;

extracting an identification parameter from the block divided first signal and storing the identification parameter in a first memory block operably coupled to the first receiver;

receiving the block divided first signal at a second receiver of the plurality of receivers;

extracting the identification parameter from the block divided first signal and storing the identification parameter in a second memory block operably coupled to the second receiver; and

selecting successively at least one block divided first signal to output from at least one of the first and second receivers of the plurality of receivers of the signal selecting system.

3. The method of selecting data blocks in a signal selecting system according to claim 2, wherein the steps of:

extracting an identification parameter from the block divided first signal; and

storing the identification parameter in first and second memory blocks; further include the steps of:

monitoring a signal quality parameter at the first and second receivers; and

storing respective first and second signal quality parameters with the identification parameter in the first and second memory blocks.

4. The method of selecting data blocks in a signal selecting system according to claim 3, further comprising the step of:

comparing the signal quality parameters of data blocks at the first and second receivers during a transmission of the block divided first signal and in response thereto to successively select a preferred receiver from which to output data blocks.

5. The method of selecting data blocks in a signal selecting system according to claim 1 wherein a signal quality threshold level is used to switch from the first receiver to the second receiver during the data session in the step of switching.

6. The method of selecting data blocks in a signal selecting system in accordance with claims 2-4, wherein the identification parameter is placed in at least one header frame of a data session.

7. The method of selecting data blocks in a signal selecting system in accordance with claims 2-4, wherein the identification parameter indicates the source of a received signal.

8. The method of selecting data blocks in a signal selecting system in accordance with any of the preceding claims, wherein each data block received at the plurality of receivers is assigned a signal quality parameter by the respective receiver.

9. A method of selecting data blocks in a signal selecting system substantially as described herein before with respect to FIG. 2 of the drawings.

The Patent Office

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**Application No:** GB 9611205.7
**Claims searched:** all

**Examiner:** Nigel Hall
**Date of search:** 13 August 1996

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4L (LDDSX, LDDRS, LDDRX)

Int Cl (Ed.6): H04B 7/02, 7/04, 7/08; H04L 1/02, 1/06

Other: Online: WPI, INSPEC

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| A | EP 0643542 A1 | (SIEMENS) See abstract | |
| X,A | EP 0522773 A2 | (AT&T) See particularly col. 25, lines13-31 | 1,2 at least |
| X,A | WO 95/32594 A1 | (NTT) See abstract | 1,2 at least |
| A | WO 91/07036 A1 | (QUALCOMM) See p.25, lines 8-14 | |

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|---|---|---|---|
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